IT University of Göteborg

CHALMERS | GÖTEBORG UNIVERSITY

Master Thesis in Informatics

REPORT NO. 2008:055

ISSN: 1651-4769

Department of Applied Information Technology

Application Portfolio Management

A Framework for Application Destiny Determination

JIMMI KELLERMAN

PATRIK LÖFGREN

CHALMERS

UNIVERSITY OF GOTHENBURG

IT University of Göteborg

Chalmers University of Technology and University of Göteborg

Göteborg, Sweden 2008

Application Portfolio Management

A Framework for Application Destiny Determination

JIMMI KELLERMAN, PATRIK LÖFGREN

Supervisor: Jonas Landgren

Examiner: PhD Thanos Magoulas

Department of Applied Information Technology

IT University of Göteborg

Göteborg University and Chalmers University of Technology

SUMMARY

Maintaining a sound and meaningful portfolio of applications is a struggle for many organizations. Applications are developed in-house, bought in and added through mergers and acquisitions in a continuous and often uncontrolled manner. The scientific literature on the subject of Application Portfolio Management (APM) is mainly focused on matrices, which are adequate for obtaining an overview but not sufficient for reaching informed decisions about how to deal with an application. The goal of this study has been to find key principles which can be used to successfully manage an application portfolio and to find out how these principles can support decisions about the destiny of an application. Our investigation has showed (I) That Business Value, Functional Value, Technical Quality and Cost are key principles for deciding the destiny of an application. (II) That decisions related to Application Portfolio Management imply transforming information about the state of the application into action while the key principles give a notion of state. The relevant actions that occur are to remove the application completely (Remove), to leave the application as it is (Remain), to transform the application (Redevelop), or to replace the application with an alternative (Replace). (III) The key principles have been used as a foundation for the design of the Framework for Application Destiny Determination (FADD) which, in a functional and intelligable way can decide the destiny of an application. The intention of the framework is to help managers reach better informed decisions about the destiny of applications in the portfolio, and the usefullness, and integrity of the framework was evaluated on two applications which implied that the framework is satisfying for decision-makers in the organization where this assessment was carried out.

The report is written in English.

Keywords: Application Portfolio Management, APM, IT Management, Business Contribution, Decision-making.

PREFACE AND ACKNOWLEDGEMENTS

The work presented in this master thesis was performed during the spring of 2008 at Volvo 3P Göteborg. It is a compulsory moment in obtaining the master degree in Applied Information Technology at IT University of Göteborg.

We would like to express our gratitude to our supervisor Ph.D. Jonas Landgren at IT University of Göteborg for his guidance during this work. We would also like to thank Fredrik Jönsson and Håkan Nilsson at Volvo 3P for supporting us with thoughts and ideas, Ph.D. Kalevi Pessi and Ph.D. Thanos Magoulas for providing us with scientific literature relevant for our study and Johan Alviander and Catharina Voldstedlund for their support.

Finally we would like to thank those who have been directly or indirectly related to the successful accomplishment of this project.

Göteborg, June 2008

Jimmi Kellerman and Patrik Löfgren

TABLE OF CONTENTS

INDEX OF FIGURES

INDEX OF TABLES

1 INTRODUCTION

This chapter will introduce the reader to the subject of this master thesis by first giving a problem background about the area of research, a description of the problem that will be subject of our investigation followed by a presentation of how other researchers approach the problem area. Finally the structure of the report is presented giving an overview of the parts that constitutes this master thesis.

Today, most organisations in all sectors of industry, commerce and government are fundamentally dependent on their information systems (Ward & Peppard, 2002). Investments in information systems (IS) and information technology (IT) represent a great deal of many organisations annual budget (Lin & Pervan, 2002). According to Marco (2002) companies spend approximately 5.5 percent of their total revenues on IT-related activities and most companies have dozens of IT projects running simultaneously. At the same time organisations approach the paradox of doing "more with less", they seek new ways in which to leverage the existing IT portfolio as well as keep pace with constant technological advancements (Catchpole, 2004).

The organizational demands for a sound and healthy IT environment are reaching new levels, not only in order to obtain advantages against competitors, but merely to survive in an increasingly competitive market. Knowing what you have and deciding what to do with it are questions that seem fairly straightforward to answer, but that may not always be the case. Application Portfolio Management is, in short terms, aimed at helping organizations answer those questions. In this master thesis you will find key principles for successfully managing an application portfolio in addition to a framework which supports decision-makers in making better informed decisions for how to deal with their application portfolio.

1.1 BACKGROUND

In order to support their activities, organisations have created information systems since the 1960's. Foundations, visions and available technology have been acting as guidance for how to develop information systems in practise. Some principles have settled the way and the application of these principles have created a complex world of information systems and an increasing critical problem area for many organisations. Early in the 1960's there was a vision that all information within an organisation could be concentrated and managed through a totally integrated system, however, this vision failed on its own absurdity. During the 1970's departments within the organisations started developing their own detached information systems, resulting in extensive manual efforts transferring information between different information systems due to the introduction of personal computers during the same decade. Further problems were inconsistency and double storing. This course of events accelerated enormously during the 1980's with an increasing importance to integrate different information systems. However, the integration was often based on more or less arbitrary principles. Evidently, the majority of the IS architectures have evolved more or less without strategies, policies or governance resulting in several problems. (Magoulas & Pessi, 1998)

Many organizations have disparate production of applications and many applications have undergone years of maintenance and enhancement efforts which in turn have reduced modularity and increased complexity (Sarissamlis, 2006). According to Magoulas and Pessi (1998), the foundation for migration towards a better architectural surrounding is the legacy of IS/IT that almost every organization carries. Legacy systems are in a constant need of maintenance and in 1993 Hanna stated that the effort to maintain legacy applications was using up the resources needed for developing new ones. A more recent study by Sarissamlis (2006) indicated that costs for maintenance and support constitute nearly 70 percent of the total cost of an application lifecycle. A reason is that many applications are still written in obsolete programming languages using old database systems. Many

systems also have redundant functionality as a result of mergers and acquisitions where the IS/IT portfolio seldom was looked into, but also because no full picture of the total IS/IT portfolio on the enterprise level has existed (Lindström, 2006). What is more, the applications in the portfolio need to be planned and managed according to their existing and future contribution to the business (Ward & Peppard, 2002).

According to Magoulas and Pessi (1998), the application architecture and the system architecture are synonymous and define the main applications needed to handle data and support the organisations functions. They also states that the focus of IT management is, among other things, to give guidance for which systems are needed, how they are going to interoperate and how to migrate from the current situation. A common aspiration is to get control over this great number of systems. Another aspiration is to terminate systems that do not provide sufficient business value any more. Yet another aspiration refers to several ways to get more out of the legacy systems compared to today. (Magoulas & Pessi, 1998)

Businesses are critically dependent on their information systems, not only for success, but also for survival. In order to assess and prioritize what actions to take it is necessary to examine the current IS/IT environment (Ward & Peppard, 2002). In the next section you will be introduced to the problem that this study comprises.

1.2 DISCUSSION OF THE PROBLEM

In this study, a business unit within a multinational company in the transportation industry, Volvo 3P, has been investigated. Their main problem areas are low rate of application flexibility, difficulties related to legacy applications and lacking control of their application portfolio. To deal with the situation they have begun investigating a way of increasing the control of the application portfolio and define a strategy for how to deal with this issue in the future. They have just completed an application inventory, which showed a possession of 300 applications with the average application age estimated to 9 years.

The intent of their initiative is not only to rejuvenate the portfolio and gaining more control, but also to increase the level of alignment between business and IT, and prepare for changing requirements in the future. Legacy is not solely an effect of an application portfolio that has grown within the business unit. Since the business unit is a part of the larger multinational organization and handles purchases and development for the whole company, the business unit also had to accept legacy from companies that have been included in the organization more recently. Mergers and acquisitions like these are commonplace today which makes it even more important to prepare for changing requirements of the business and IT relation.

The purpose of this master thesis is to create a framework for supporting decision-makers in making better informed decisions about what actions are best for dealing with the applications in the portfolio. To be able to decide the action, this master thesis will examine key principles important to consider when managing an application portfolio. Thus, the research questions answered in this master thesis are:

Which principles are key to successfully manage an application portfolio?

How can application destiny decisions be supported by these principles?

We will answer the questions by examining an application portfolio management initiative within the business unit and find out how the problem is addressed in the scientific literature. This will give us an empirically as well as theoretically founded understanding of the aspects important in decision-making about applications within an organization. With this knowledge we will set out to create a framework that can be used by managers when deciding the actions of their applications. Before that, we will introduce the reader to how this problem area has been dealt with in prior research.

1.3 RELATED RESEARCH

According to Ward (1987), the most common way of visualizing a portfolio is through the use of different matrices. The approach has been adopted because of the way it reduces a large set of alternatives into a comprehensible number of options. One of the first and most well-known matrices for classification of IS environments is the Strategic Grid, which was developed for the purpose of assessing an organization's total application portfolio and determine the management approach required from the business (McFarlan et al., 1983). Since 1983, the Strategic Grid has been complemented and enhanced by various models and Ward (1987) investigated the usefulness of matrices for helping management make informed decisions regarding how IS/IT should be developed in the organization taking account of the ideas raised by each matrix, identifying key issues and by that produced a composite matrix for IS/IT strategy work.

Weill and Vitale (1999) introduced the Health Grid which has technical quality on one axis and management value on the other and the four options, Upgrade, Nurture, Question or Consolidate/Eliminate. The Health Grid is not very different from the Legacy Matrix proposed by Sommerville (2001), which is constructed with business value instead of management value on one of the axises. Nhampossa (2004) investigated strategies to deal with legacy information systems using Sommerville's Legacy Matrix, the primary concern of the study being the processes involved when dealing with legacy information systems.

There are, however, not all organizations that are ready for adopting this kind of solution. Hirvonen (2004) investigated how the maturity of an enterprise affect how the organization benefits from using application portfolio models for planning, evaluating and managing information systems and concludes that in order to use the matrices a certain level of maturity is necessary.

Fabriek et al (2007) defines a rationalization approach for the application portfolio, dealing with reducing the complexity of existing applications in the portfolio. By using the rationalization approach, an organization can analyze the application portfolio and group applications based on e.g. technical quality and uncommon programming language and thereby make a decision about the whole category, to discard (parts of) them, replace them, redevelop them or invest in new applications.

Kwan and West (2004) proposed a model for analysis of all systems in an organization considering the relative importance of the applications and the respective alignment to strategic goals. The resulting framework contains four stages of IT importance: support, mission critical, strategic and laboratory. These showed that the importance of an application changes over time.

At last, Swanson and Dans (2000) made their study in the area of systems retirement and replacement. They investigated the relation between maintenance effort and system life expectancy and found among other things that larger systems are associated with a greater life expectancy, not only a greater maintenance effort. They also found that older systems have shorter remaining life expectancy, as should be expected, but also that there is no direct association between older systems and greater maintenance effort. Furthermore, Swanson and Dans suggest that instead of extending a systems useful life by allocating greater maintenance efforts, one should let the expected remaining lifetime of a system decide the maintenance effort.

When concluding related research for application portfolio management, we distinguish that a majority involves matrices for solving problems related to application portfolios. In turn, the matrices consider a number of different aspects which are described as important for managing an application portfolio.

1.4 DISPOSITION

Chapter 1: Introduction – In this chapter the reader is introduced to the topic of this master thesis and provided with a problem background for the study along with a discussion of the problem that is examined.

Chapter 2: Research Method – In this chapter an explanation is given to how the research was conducted and how this master thesis was constructed in an academically proper way.

Chapter 3: Application Portfolio Management - In order to create a foundation for future evaluation and analysis of an application portfolio initiative, this chapter describes portfolios and portfolio management in addition to the objectives and tasks associated with this approach. Methods and models for application portfolio management are the main subject of the remaining sections of this chapter.

Chapter 4: Volvo 3P – In this chapter the result of the empirical study is presented. Firstly the business unit is presented and the motive for the work that is being done within the organization followed by what has already been done and where the work is going next.

Chapter 5: Analysis of the portfolio work practice – This chapter starts with an analysis of the academic concept of Application Portfolio Management and how this relates to the view of the organization followed by a breakdown of how an application can be handled. Thereafter, the principles that are later used for creation of the framework are presented and motivated.

Chapter 6: Framework for Application Destiny Determination – This chapter contains an explanation of the fundamentals of the framework and how it should be used at an aggregate level, followed by a presentation of the logic of each step in the framework. The final section contains some criticism to the framework.

Chapter 7: Evaluation of the Framework – In this chapter the framework is applied and evaluated on two applications in the target organization in order to assess the usefulness and increase the reliability.

Chapter 8: Concluding Discussion – Our conclusions based on the analysis is presented in this chapter accompanying a brief discussion of the results from the evaluation of the framework. In this chapter the answers to the research question is presented, in addition to a few suggestions for further research.

2 RESEARCH METHOD

The purpose of this chapter is to describe how we conducted our research, which scientific methods that our study is based on and the data collection methods used in order to answer our research question. The study can be divided into three phases, narrated by Earl in Löwstedt and Stjernberg (2006): i) Exploration, ii) Examination, and iii) Explosion. The purpose of the first phase, Exploration, is reconnaissance in order to confirm worthiness of the research question and at the same time discovering or confirming appropriate methodology. In the Examination phase, our investigation became tighter and more defined. In short, this is where the core data for our conclusions were collected. In the Exposition phase, the study and collected data was tested and verified to be able to make further conclusions.

The initial contact with Volvo 3P was made in October 2007, as we (the authors) were performing an interview for another study. We were told that Volvo 3P were about to undertake an enterprise architecture project, which raised our interest. Three months later, two semi-structured interviews were performed in order to understand their work and to define a problem area. According to Trost (1994), a research study should always start with a problem definition. It is important to reach a clear understanding of why the study should be performed and what the purpose of the research is.

Volvo 3P's Global Process and IT Manager (Respondent 1) and an Enterprise Architect from Volvo IT (Respondent 2), who was leading the application portfolio initiative at Volvo 3P, participated in both interviews. They provided a brief understanding of the background and problem area (see 4.2). Application portfolio management was the main topic of these two interviews, but we also discussed the organization's overall enterprise architecture initiative.

After the interviews, a literature review was made in order to understand the area of our research. The literature consisted of books and research articles mostly from University of Goteborg and Chalmers University's libraries and electronic sources such as IEEE and JSTOR. We also used electronic sources such as BRINT Institute (www.brint.com) to browse several databases for relevant information in addition to articles from Gartner Group and Forrester Research Inc. Relevant literature was analyzed, arranged and presented in chapter 3.

In order to capture other relevant aspects, we consulted two PhDs for three meetings, which in average lasted for one hour. At the meetings, we discussed both the general problem background and the challenges that Volvo 3P confronted. In addition, the two PhDs gave us suggestions for further scientific literature relevant for our study.

2.1 SCIENTIFIC APPROACH

For this study we have used in-depth interviews (Easterby-Smith, Thorpe and Lowe, 2002) which provide us with more contextually detailed (richer) data because of interactions between individuals and groups (Glazier & Powell, 1992). We have used a qualitative method, because it is flexible, allowing the researcher to adapt the study by adding or changing questions during the process (Holme & Solvang, 1997). It also concern direct observations and analysis of documents and materials (Marshall & Rossman, 1998). Our procedure for in-depth interviews and direct observations is presented in section 2.2.1 and 2.2.2, the analysis procedure of documents and materials is presented in 2.2.3.

2.2 DATA COLLECTION

There are two main definitions of the outcome of data collection: primary data and secondary data (Bell, 1995). According to Bell, primary data is material that we have been gathered for a defined purpose, secondary data is material that has been collected by others but used by us. Our primary data consists of several interviews, participant observations and a workshop. Our secondary data consists of documents and materials provided by our assigner. In the next sections we are about to present our data collection.

2.2.1 INTERVIEWS

All our interviews have been performed in a semi-structured way, which allowed us to use predetermined questions and change the order of the questions if needed. In addition, a semi-structured way enabled us to add or remove questions during the interview as a result of what the respondent says (Robson, 2002). The predetermined questions we used comprised Volvo 3P's problem background, work procedure, future objectives, aspects that the respondents found important for the application portfolio initiative as well as roles and responsibilities.

We have used two types of interviews in our study: respondent interviews and informant interviews. A respondent interview comprises interviews with people working in our target organization who are working with the topic investigated in this master thesis. An informant interview involves people that are outside the company, but has certain knowledge about the topic which can help us to see things from another perspective (Holme & Solvang, 1997).

During our study we completed five respondent interviews and two informant interviews; the length of each one was approximately one hour. All interviews have been recorded on an mp3 player and transcribed later the same day. The reason for why we recorded the interviews was to give us the opportunity to be more active during the interviews and to reduce the risk of missing important information. However, we took turns taking notes and asking the questions during the interviews in order to write down thoughts that arose. Further notes were taken directly after the interviews as we discussed the answers and our general impressions. The outcome of the interviews can be found chapter 4. Answers from the respondents also gave us inspiration for further literature studies which in turn resulted in modifications in chapter 3.

INFORMANT INTERVIEWS

To reach a wider understanding of the problem area and to capture other relevant perspectives of our topic, we decided to perform two informant interviews. The informants were selected based on ease of access and consisted of an IT strategy consultant and a management consultant working with coordination of IT for business cooperation. Both the informants highlighted the importance of managing legacy applications from a management perspective. One of them suggested that we should found our work on ITIL (Information Technology Infrastructure Library), which is the most widely accepted approach to IT Service Management. But since the ITIL-definition of the term *application* differed from the definition Volvo 3P used and since we wanted a more academic founded approach for managing the application portfolio, we decided not to follow the suggestion.

RESPONDENT INTERVIEWS

The respondent interviews were performed with employees at Volvo 3P in Göteborg who are working with the application portfolio initiative in one or another way. The respondents were selected by ease of access. To increase the reliability and validity of the study, we would have liked to perform interviews and/or sending out questionnaires to some of the system owners and users of the applications in order to capture their opinions about the applications that they were familiar with. But since our supervisor at Volvo 3P thought that it would take up to much time, we were not authorized to do that. However, we think that our result has enough reliability and validity since we had access to a number of documents and the information collected at the workshops performed

by the EPO team (those in charge for the application portfolio initiative at Volvo 3P) in collaboration with system owners at Volvo 3P.

2.2.2 PARTICIPANT OBSERVATIONS

When the EPO team collected information about the application portfolio, they arranged workshops with system owners of each application (see 4.3). To capture the discussions evolved, we had the opportunity to participate in four of these workshops. The length of each one was approximately one hour and was recorded and transcribed afterwards. The purpose of participating was to see how the application information was collected and what they discussed, but more important what they did not discuss in relation to their application portfolio objectives and what the scientific literature consider important.

2.2.3 DOCUMENT STUDY

The application information extracted in the workshops was collected in an Excel file (referred to as the PAI sheet). We had the opportunity to examine and analyse this file, consisting of information concerning approximately 200 applications. This gave us valuable information about the application portfolio, but also which information the EPO team considered important. When examining the PAI sheet, we came up with some main aspects considered by Volvo 3P, presented in Table 4-1.

In addition to the PAI sheet, we also received other documents which helped us to understand the background to the work and what have been done so far. Because of confidentiality we cannot display all the information from these documents, but important parts of it is presented in chapter 4.

2.2.4 WORKSHOP

As we were starting to feel comfortable about the progress of our study, we performed a workshop with Respondent 1 and Respondent 2. According to Löwstedt and Stjernberg (2006), workshops are considered as an appropriate method to provide feedback, both to participants and in return back to the researchers. We started the workshop with a presentation of our framework (see chapter 6) for the respondents. This took approximately 20 minutes. After that we had a question time, for our assigner to ask additional questions about the framework and for us to make a verification of collected data and made interpretations. The next step was to proceed and apply the framework on some applications in order to further explore how it works. The results can be seen in chapter 7.

3 APPLICATION PORTFOLIO MANAGEMENT

This chapter presents the academic foundation for the upcoming analysis and discussion. Starting with an introduction to highlight the importance of a connection between business and IT we move on to describe portfolios, portfolio management and application portfolio management in addition to the objectives and tasks associated with this kind of approach. Methods and models for application portfolio management are the main subject of the remaining sections of this chapter.

3.1 THE RELATION BETWEEN BUSINESS AND IT

The linkage between business and information technology, sometimes referred to as alignment (Henderson & Venkatraman, 1999), is an important objective for information systems managers (Horner Reich & Benbasat, 1996). Obtaining a fit between IT and business is not going to happen by itself and information technology, no matter how state of the art, will not bring any benefits unless it is exploited continuously and shaped to the business needs (Henderson & Venkatraman, 1999). The way of managing IT assets is more important for organizational performance than the level of spending (Irani, 2002) and according to Ward and Peppard (2002), it is very likely that there exists a gap between the current IT environment and what is necessary to satisfy future needs.

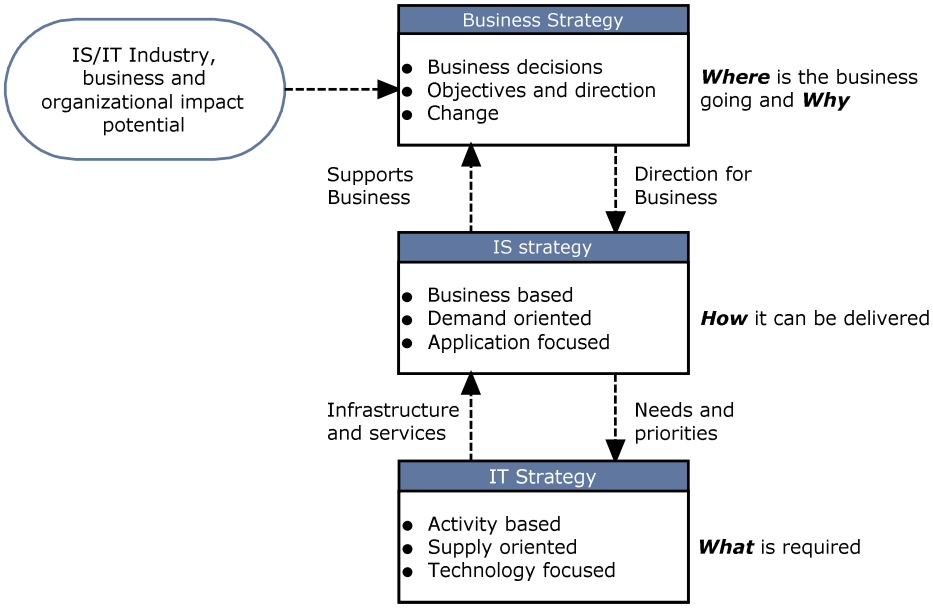

Figure 3-1 Relationship between business, IS and IT strategies (Source: Ward & Peppard, 2002).

As depicted in Figure 3-1, IS should be based on business needs and oriented to satisfy the demands of the business, it should be a supporting function to the organization. According to Hirvonen (2004), the quality of the IT environment has a direct impact on the value of the business and managerial tools such as portfolios are suggested to support decision making and evaluation.

3.2 PORTFOLIOS AND PORTFOLIO MANAGEMENT

Portfolios are a well-known decision making tool in the management literature (Renkema & Berghout, 1996). A portfolio can contain anything that we need to manage, such as for example businesses, investments or assets. Investments and assets can, or should be, categorized based on their type/characteristics (Menke, 2006). In addition, portfolios should manage both decisions and execution. A portfolio is a structured grouping of business investments selected by management to achieve defined business results. In addition, portfolios are stated as none-static, in fact the term portfolio indicates the need to balance potential opportunities to deliver the most value over time, and allowing a varied future (Thorp, 2001). Consequently, portfolios need to be carefully managed.

Portfolio Management has been applied to financial investments for decades, enabling decision makers to choose among an increasing number of complex options in an ever-changing environment (Thorp, 2001). At its core, Portfolio Management describes the processes, practices and specific activities to select (IS/IT) investments (CIO Council, 2002). According to Menke (2006) Portfolio Management is about allocating resources (i.e. deciding/choosing) among opportunities competing for limited resources. Menke establishes Portfolio Management as the process of actively and dynamically evaluating, prioritizing and selecting among investments and assets in order to monitor, track and re-prioritize investment opportunities or assets to create optimal business value. CIO Council (2002) defines Portfolio Management as:

> *…use of continuous and consistent evaluation, prioritization, budget considerations and finally selection for the greatest value and contribution to the strategic interests of the organization.*
>
> *CIO Council, 2002, p4*

The primary objectives of Portfolio Management are to identify, select, monitor, finance and maintain a suitable mix of programs and projects to achieve organizational objective, and the focus is at an aggregate level (CIO Council, 2002). To categorize and visualize the components in a portfolio, the scientific literature provides several different matrices.

A frequently used portfolio matrix in many strategic analyses is, according to Ward (1987) the Boston Matrix. The Boston Matrix distinguishes between Star, Problem Child, Cash Cow and Dog and furthermore provides a life cycle to the portfolio approach (Renkema & Berghout, 1996). The Boston Matrix is based on the two concepts, product life cycle and the relation between market share and profitability. The product life cycle explains how the market for a product changes over time and like the concept of a product life cycle, some matrices also demonstrate relations that change over time, from introduction and market acceptance over growth to maturity and eventually to declination, depending on the demand. Life cycles can be quite different in duration and not all products follow the same cycle. While some never get off the drawing board, others never gain market acceptance. The life cycle is often divided into the four phases: Emerging, Growth, Mature and Decline (Ward & Peppard, 2002).

Ward (1987) presents and analyses a number of two by two matrices with the intent of helping how to assess IS/IT in its extended role. One of the first and most well-known matrices for classification of IS environments is the Strategic Grid, which was developed for the purpose of assessing an organization's total application portfolio and determine the management approach required from the business. The Strategic Grid relates; How IS/IT is affected by the market forces in which the business competes and How IS/IT is currently contributing to the business (Ward, 1987). The matrix consists of the four fields Strategic, Turnaround, Factory and Support. *Strategic* relate to existing and future systems that are critical to business success; *Turnaround* relate to future systems investments that could become more important than existing systems; *Factory* relate to existing systems that are important for the organization but further investments implies little further benefits and; *Support* relate to IS/IT which cannot be seen as and will not become critical to the business (Ward & Peppard, 2002).

The two portfolio matrices described above are just a brief selection of potential portfolio matrices provided by the scientific literature, focusing on similar issues from different perspectives. Portfolios for managing information systems, i.e. application portfolios (Magoulas & Pessi, 1998), are the subject of the following sections.

3.3 METHODS AND MODELS FOR APPLICATION PORTFOLIO MANAGEMENT

Application is a term that has a double nature, consisting of the general use of IT to carry out specific tasks such as e-mail, computer-aided design or preparing presentation materials, and the use of IT to support specific business activities or processes such processing orders, forecasting or purchasing. Application portfolios is a means of assessing how existing, planned and potential applications contribute to achieving business goals (Ward & Peppard, 2002) including the work force dedicated to related services, all of which must be managed like a financial portfolio, balancing risks and budgets to meet management objectives (Weill & Broadbent, 1998). In this study we have been inspired by the approach provided by Ward and Peppard (2002), because it contributes to the business value and impact of current and potential applications. While the application portfolio approach suggested by Weill and Broadbent, instead relates to different management objectives. The outcome of a sound Application Portfolio Management (APM) is according to CIO Council (2002) a better understanding of what will be gained or lost through the inclusion or exclusion of particular applications. APM enable an organization to assess the tradeoffs among competing applications in the portfolio in terms of their benefits, costs and risks (CIO Council, 2002).

3.3.1 METHODS FOR APPLICATION PORTFOLIO MANAGEMENT

The scientific literature relates to several different application portfolio methods, which generally aim to "assess the health of an IS application portfolio" (Weill & Vitale, 1999), "rationalize the application portfolio" (Fabriek et al, 2007), "propose strategies to deal with legacy information systems" (Nhampossa, 2004) and "enterprise IT portfolio management" (Kwan & West, 2004). In these methods for application portfolio management, we have distinguished five general principles for evaluating an application portfolio: Business value, Investment value, Technical quality, Functional value and Management value. Weill and Vitale (1999, p 604) makes an additional statement: "each system in the portfolio has a perceived importance, a cost, a technical quality, a frequency of use, and a perceived management value". A large part of the value assessment should, according to Sommerville (2001), be seen as subjective values. This is investigated further below. First, we are about to introduce the five principles [1].

1. ***Business value*** explains the business importance of an application to meet business goals. The goals of IT and business must be aligned (Henderson & Venkatraman, 1999) in order to be seen as valuable for the organization, even if they cost a lot of money to produce or a lot of time to maintain. Business value is a key attribute of any application and is suggested as one of the factors that determine how much will be invested in an application and how often it will be used (Weill & Vitale, 1999).
2. ***Investment value***, or total financial cost, of the application is a measure that can be used to objectively compare applications. The investments usually constitute costs for purchasing, operations, and maintenance of the application (Weill & Vitale, 1999). According to Ward and Peppard (2002), the investment justification of an application is related to the value it delivers to the business.
3. ***Technical quality*** of an application has several characteristics. Data accuracy and reliability, source code quality, output quality and response time will influence maintenance work and use of resources. If these are poor, the technical quality of the application will decrease (Weill & Vitale, 1999). Sommerville (2001)

[1] Each of these five elements consists of a number of aspects which have to be considered. We have, however, decided not to reproduce this list. To come up with a complete list of these aspects we refer to Weill and Vitale (1999), Sommerville (2001, p592-598) and Fabriek et al (2007).

states that "system quality assessment" includes both application software, but also the business processes and the hardware and support software environment of the application. Technical quality is suggested as an important factor for the usage and performance of an application (Weill & Vitale, 1999).

4. ***Functional value*** refers to the usage of the application. One way to assess the value of use is to examine the use of all applications. The use of an application is a behavioural indicator which acts as a surrogate for measuring the effectiveness of the system (Weill & Vitale, 1999).
5. ***Management value*** is, according to Weill and Vitale (1999), an indicator of the usefulness of a system to senior managers for performing their job.

Much of the value assessment for the five principles above is subjective judgements without reliable objective method. It is important to consider how to assess subjective value in order not to get a skew value as a result of relying on just one opinion. For that reason, Sommerville (2001) recommend adoption of a viewpoint-oriented approach where a number of business viewpoints are identified and value assessments are made from each of them in order to provide a fair picture of the circumstances. These viewpoints can be divided into End-users of the application, Customers, Line managers, IT managers, and senior managers. To the *End-users of the application*, Sommerville propose questions which determines how effective they find the application supporting business processes and how much of the application functionality is used. To understand the *Customer* viewpoint, factors related to application performance are found, and to understand the *Line managers*, factors related to application efficiency, costs and business critically are important. The main issue for the *IT managers* is to estimate how much resources the application consumes in terms of staff and maintenance efforts. For *senior managers* it is important that the application and associated processes make an effective contribution to the business objectives. After these viewpoints have been identified, people from each viewpoint should be interviewed and their answers collated. This will provide an overall picture of the application value to the business which brings better informed assessment of the subjective values. (Sommerville, 2001)

Some of the methods for application portfolio management (Weill & Vitale, 1999; Sarissamlis, 2006; Fabriek et al, 2007) can roughly be divided into the three phases: Assessment, Evaluation and Planning (Fabriek et al, 2007). Each phase has its own objectives and characteristics, which is presented below.

1. The ***Assessment phase,*** gather and depict all information concerning the applications and the complete set of applications, the application portfolio. Obtained information will be used in the evaluation and planning phases. To investigate which applications are useful or useless, the value of each application should be assessed. To make decisions about the application portfolio, each application can be categorized and evaluated on its value established in the assessment. In the assessment phase, the portfolio can also be made visible by describing and categorizing the applications in technical dimensions such as: database, shared business processes, functionality, shared infrastructure, programming language. Describing the application portfolio in such terms can help an organization to execute specific business decisions, for instance to remove all applications implemented using an obsolete programming language or database. (Fabriek et al, 2007)
2. In the ***Evaluation phase***, a discussion should be brought up in order to highlight the main problem areas of the application portfolio. Both value and technical aspects should be evaluated. Before the evaluation, the categorization and outcome from the assessment should be reviewed together with managers from different departments (Weill & Vitale, 1999) in order to minimize bias that can occur when the (IT) employees perform the assessment (Fabriek et al, 2007). Fabriek et al suggests that health grids be used for evaluating the portfolio in this phase.
3. In the ***Planning phase,*** the outcome from the assessment and evaluation should be used in order to determine what actions to take and where the resources should be directed. The organisation can decide to replace, redevelop, discard or reinvest in applications based on the results from the previous phases. The actions will require time and money, and allocating the resources to gain the best effect does not mean only to look for the quick wins but involves looking at current and future goals. (Fabriek et al, 2007)

3.3.2 MODELS FOR APPLICATION PORTFOLIO MANAGEMENT

Application portfolio management models (matrices) provide the means for balancing the portfolio and the life cycle of applications. They also provide management with different approaches to meet organizational objectives and to maximize benefits. There is, according to Ward (1987), one main problem when using a matrix for application portfolio management: they are over simplistic. Such a simplification of a complicated situation limits the usefulness since no precision can be expected and it can be used merely to enlighten management about an area of conflict and uncertainty (Ward & Peppard, 2002).

The application portfolio matrices presented in the following sections provide similar concepts to those found in financial portfolios (e.g. the Boston Matrix) whose primary purpose is to find the best strategic combination of portfolio items and optimize their use. Application portfolio matrices were originally developed for IS/IT asset management purposes (Hirvonen, 2004) and historically, traditional portfolio models show the relationship of systems to each other and the tasks being performed, rather than the relationship with business success (Ward & Peppard, 2002). Examples of matrices more specialized for managing application portfolios are the Application Portfolio Matrix (Ward & Peppard, 2002) and the Legacy Matrix (Sommerville, 2001) presented in the next two sections.

APPLICATION PORTFOLIO MATRIX

The Application Portfolio Matrix provided by Ward and Peppard (2002) is primarily derived from the work of McFarlan (McFarlan et al., 1983). While the Strategic Grid is intended to plot the overall expected contribution of IS/IT to business success, Ward and Peppard's Application Portfolio Matrix (Figure 3-2) is used to plot the applications based on their potential contribution to achieving future business goals and the degree of dependence of the business for achieving overall business performance.

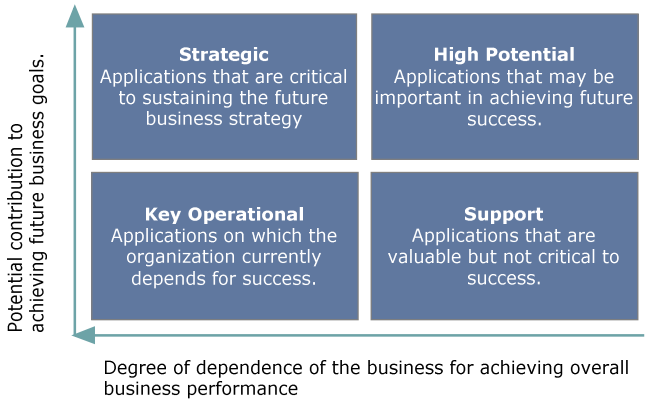

Figure 3-2 Application Portfolio Matrix (Source: Ward & Peppard, 2002).

The model suggests that all existing, planned and potential applications are plotted into the four categories; Strategic, High Potential, Key Operational and Support, which are further described below. There is no value in simply classifying the applications into a matrix unless this causes a more effective management of each application. Since the discussion involved will enable different perspectives to be understood, the process of classifying the applications is just as important as the end result. An application can be classified differently based on differing perceptions of its role and contribution to the business in different groups of stakeholders, which should open for a discussion. If there is no way of getting an agreement, whether the application should be assessed as a Strategic or Support, it is possible that the system should be considered at a lower level if it is consisting of several business processes or sub processes. Some of the underlying processes may be more business critical than others and as a consequence, the classification should always be based on business contribution of the application and not the application itself. (Ward & Peppard, 2002)

According to Ward and Peppard (2002), the approach to manage applications are different depending on the type of application. *Why* does the system exist? *What* is required of the system? And *How* can it be accomplished? Are questions that may offer guidance on how best to manage each application through its lifecycle.

Figure 3-3 depicts how the complexity of the questions changes when moving around the matrix. *Support applications* are relatively straight forward since the main objective (Why) being improvements in efficiency, and the existing tasks and activities determine the What, thus the How will imply how it shall be done in terms of cost-effective use of IT. For *Key Operational applications*, improving performance and avoiding disadvantage answers the Why. To answer How it can be done, the What first has to be defined and to Which systems. In the *Strategic applications* field, the Why, in strategic business terms, needs to be resolved in addition to the How and the What. It is important that the rationale (Why) for strategic systems is explicitly and coherently derived from the business strategy of the organization. *High Potential* applications are applications where one or two of the Why, What and How questions has not been answered which implies that further evaluation is necessary to answer the remaining questions. (Ward & Peppard, 2002)

Strategic	High Potential
WHY: do we want to do it in strategic terms? WHAT: does the system need to do to gain the advantage? HOW: best to do it?	WHY: -not clear WHAT: - not certain HOW: -not yet known
Key Operational	**Support**
WHY: to improve performance and avoid disadvantage WHAT: actually has to improve and by how much? HOW: best to do it?	WHY: - to reduce costs by improving efficiency WHAT: of existing necessary tasks HOW: best to do it?

Figure 3-3 Key questions on the applications portfolio (Source: Ward & Peppard, 2002).

Applications have a lifecycle and move around in the matrix over time. High potential applications are risky and evaluation of whether they are strategically important or if they have potential to become Strategic is needed. When an application no longer can be characterized as High Potential, e.g. it is commonly used across the industry, it becomes Key Operational. Similarly, applications that are Strategic eventually become Key Operational when the market matures. To maximize long-term contribution of the applications, proper management in the relevant quadrant and transition across quadrants is key. Ward and Peppard (2002) emphasize some guidelines to each quadrant:

High Potential Quadrant:

1. New technology on its own does not yield any benefit – the organization must discover how to implement it in a way that delivers the benefits.
2. Separate risky ventures from mainline activities by not integrating applications in important processes until they are evaluated and the contribution to the business assessed, in order to minimize the negative impacts on the organization should the application be unsuccessful.
3. Cost control is important since High Potential applications are new but still might have to be scrapped.

Strategic Quadrant:

1. Let business drive the improvements in the system, however not only on return on investment but also based on how it will be affected if the system fails to stay ahead of competition.
2. Business processes should be continuously evaluated in order to assess how improvements in applications can increase value added.

Key Operational Quadrant:

1. The applications in this quadrant should only be enhanced or redeveloped when changes are made in the business and only in order to avoid disadvantage from those changes.
2. The quality of the applications in this quadrant is important since compromises will reduce the economic advantage when maintenance costs rise.

Support Quadrant:

1. Software packages and/or outsourcing are a valid alternative and available since the applications are similar in many companies and no competitive advantage can be gained here by in-house development.
2. Quality should be maintained in relation to the cost of failure and in general the application should not be enhanced unless return is certain.
3. Adjust the business activity to fit the application and not the other way around otherwise the costs will rise instead of drop.

As a consequence of the application life cycle, there is an increasing need for application investment justification over time because of declining business demand. Another characteristic for applications situated in Key Operational and Support quadrants is the importance of their related expenses, which becomes more decisive than for an application situated in the High Potential or Strategic quadrant. The explanation is: it is easier to make financial justifications for applications in the Key Operational and Support quadrants, where most aspect of the application are better known or can be determined; lower risks and; slower rate of change, and in addition, applications in the High Potential or Strategic quadrants can potentially deliver higher business value. Migration from High Potential via Strategic to Key Operational is the most beneficial sequence for an application and also the most common one. Mismanagement in the early stages can, however, change and reverse the outcome. In general this occurs when applications using new technologies are allowed to evolve without proper management. It is important to be aware of these four different management approaches in order to achieve an appropriate balance of resource use to business contribution. The Application Portfolio Matrix, is thus aimed at categorizing applications which will allow for better management of the applications in the portfolio. (Ward & Peppard, 2002)

LEGACY MATRIX

When an organization set out to make changes in its information systems, problems may arise due to the existence of massive, intricate and inflexible installed base of software. This is often referred to as legacy information systems (LIS), which are embedded and cannot be abandoned immediately (Sommerville, 2001). Many systems that are still in use were originally developed many years ago and implemented using technologies that are now obsolete, which often implies that LIS characteristics as slow, unreliable and inflexible for dealing with new, more diverse and demanding tasks (Nhampossa, 2004). The functions of LIS are difficult to understand and the systems are usually still critical to business survival, which makes the replacement task even more daunting. There is substantial business risks associated in scrapping and replacing a LIS. First, a LIS usually have undergone modifications during its lifetime that have not been documented properly and there rarely exists a complete specification of the LIS. Consequently, it is hard to specify a new system with identical properties as the original system, in order to replace it. Second, business processes are often depending on LIS´s. If the legacy system is replaced it is also necessary to change these processes, with unpredictable costs and resource spending as consequence. Third, legacy systems often embed business rules that are not documented elsewhere and which

may be critical. Replacing the LIS could result in a loss of these specific business rules. Sommerville suggests an assessment strategy to evolve LIS´s, which should be based on two dimensions: system quality and business value (Figure 3-4). (Sommerville, 2001)

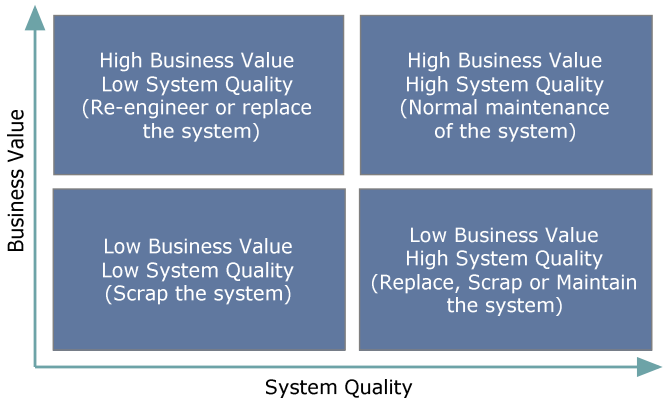

Figure 3-4 Legacy Matrix (Source: Sommerville, 2001).

If the outcome of the assessments indicates low system quality and low business value the LIS should be scrapped. Low system quality and high business value means that the LIS is important to the business, but are possibly expensive to maintain, and so should be re-engineered or replaced if a more suitable system is available. High system quality and low business value implies that the LIS should be replaced, scrapped completely or possibly maintained. High system quality and high business value implies that the LIS should be kept running using normal system maintenance. (Sommerville, 2001)

3.4 FOCAL POINTS

To summarize, this chapter highlighted the importance of alignment between business and IT, described portfolios, portfolio management and application portfolio management in addition to the objectives and tasks associated with this kind of approach. The focal points that are used further on in our study are (1) the principles narrated by Weill and Vitale (1999) and Fabriek et al (2007) refered to as; Business value, Investment value, Technical quality, Functional value and Management value, and (2) the outcome of an application assessment which is described by Sommerville (2001) as; scrap the application completely (hereafter refered to as Remove), keep normal application maintenance (Remain), re-engineer the application (Redevelop) or replace the application with a more suitable one (Replace).

4 VOLVO 3P

This study is performed in cooperation with a business unit of a multinational company which is presented in this chapter. We start by presenting Volvo 3P and their motive for the work before we continue with what has been done and where the work is going next. The information presented in this chapter is a compilation of material from interviews, observations and internal documentation which has been collected throughout the study. We introduce the result of our study in section 4.2, after a brief introduction of Volvo 3P in section 4.1

4.1 THE BUSINESS UNIT

Volvo Group, founded in 1927, is a manufacturer and supplier of transport solutions for commercial usage such as trucks, buses, construction equipment, drive systems for marine and industrial applications as well as aircraft engine components but also offers financial services to customers. Volvo Group is a global company, with presence in 180 countries and production in 19 and currently employs more than 100,000 people worldwide.

In this study we focus on one business unit, Volvo 3P (see Figure 4-1), which is mainly responsible for product planning, product development and purchasing for the truck companies. The business unit is, hence, divided into the three business functions Product Planning, Product Development and Purchasing. Volvo 3P has a total of some 3000 employees where the main part is working with product development, specializing in chassis, berths and the electrical system. The business unit is commissioned to deliver synergies and industrial efficiency which means delivering better products at a lower cost.

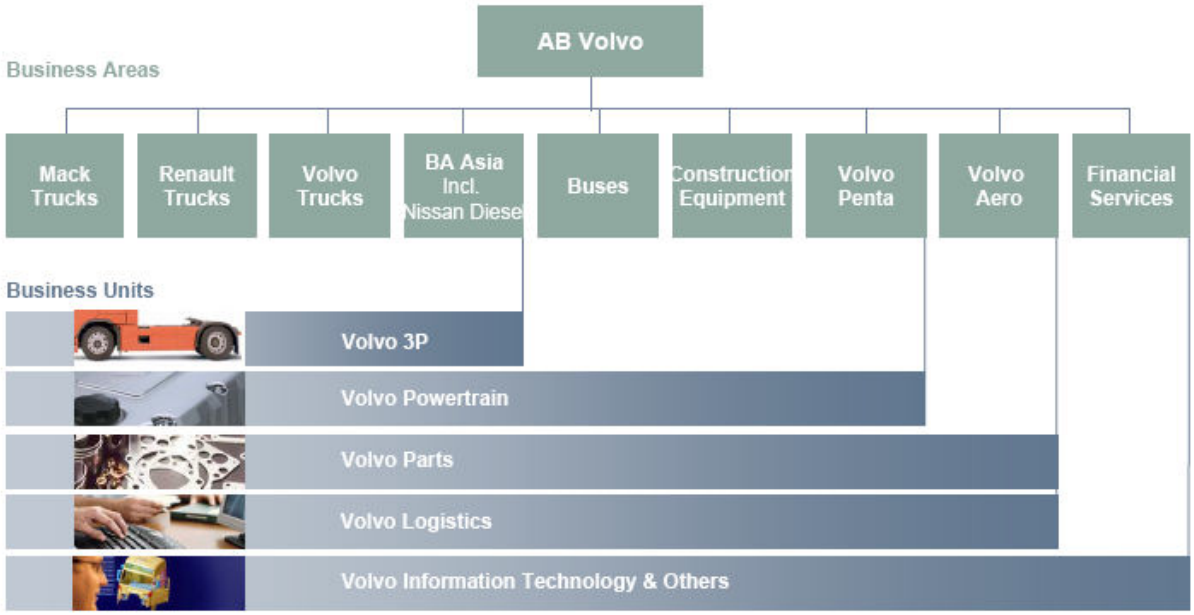

Figure 4-1 Volvo Group organization chart (Source: www.volvo.com, 2008).

With the organizational structure presented above, we will also briefly introduce roles and responsibilities important to understand the background and current work tasks presented in section 4.2 and 4.3.

The ***CIO Network*** at Volvo 3P has meetings every month and consists of CIO members from Purchasing and Product Development, Business Support, Process Owners and Enterprise Architects. The CIO Network manages policies, service and cost for IT operations and maintenance. They develop the process and IT roadmap, as a contribution to efficiency of the business unit, in link with Volvo Group. The CIO Network manages data integrity for processes and provides support for the process and IT network as well as following up performance improvements resulting of implemented projects and prioritise the level of new developments per council.

The ***EPO (Enterprise Program Office)*** consists of two enterprise architects and a few IT architects who review and guideline Volvo 3P Purchasing regarding business architecture and integrations. They are responsible for support and review integration requests from business and technical perspectives. The EPO also review IS/IT principles and define reference architecture.

System owner is the owner of an application within Volvo 3P. The system owner is responsible for Service Level Agreement (SLA) with Volvo IT and ensures that the application support business demands. The system owner has the financial responsibility of an application.

Maintenance manager should ensure that the SLA is fulfilled and also has a technical knowledge of an application. A maintenance manager is responsible for an application; its maintenance, enhancement, quality, economy and lifecycle, planning, as well as the delivery and support of it. The maintenance manager is often employed by Volvo IT but some applications are maintained by internal staff on Volvo 3P.

CAM (Customer Application Manager) is a role that Product Development has introduced as the technical expert of an application. A system owner is not always in control of his or her application portfolio, a CAM has a more operative role than the system owner who has the financial responsibility.

Power user acts as an expert of an application.

4.2 APPLICATION PORTFOLIO INITIATIVE

In this section we are about to present the outcome of our investigation at Volvo 3P, consisting of material from interviews, observations and internal documentation which has been collected throughout the study.

As demonstrated in 1.1, many organizations are facing costs of maintaining legacy applications and so is the business unit in this study. The background for the application portfolio initiative at Volvo 3P includes both business and IT components. Since the main expenditures of Volvo 3P are personnel and IT, Respondent 1 pronounce the value of an up to date application portfolio to support current and future business demands. In addition, the business unit has issues of flexibility, difficulties related to legacy applications and lacking control as a result of recent mergers and acquisitions. The business unit is still maintaining one application from the 1970`s and the average application age is approximately 9 years.

> *One problem is that we never switch off any applications, we only create new ones. The result is a number of new applications every year.*
>
> *Member of EPO*

To deal with the situation Volvo 3P has begun investigating a way of increasing the control of the application portfolio and defining a strategy for how to deal with this issue in the future.

> *With a better management of our Application Portfolio by simplifying the interfaces between applications, selecting standard technologies for IT and integration when developing applications etc, we will reach several business benefits.*
>
> *CIO Network*

The intent of the initiative is not only to rejuvenate the portfolio and gaining more control, but also to increase the level of alignment between business and IT, and prepare for changing requirements in the future. The emerging problem with legacy applications is not solely an effect of a portfolio that has grown within the business unit. Since Volvo 3P is a part of Volvo Group and handles purchases and product development for a large part of the whole group, Volvo 3P also had to accept legacy from companies that have been included in Volvo Group more recently. Mergers and acquisitions like these are commonplace today which makes it even more important to prepare for changing requirements of the business and IT relation.

> *When it comes to Volvo 3P Purchasing, all purchasing systems from the prior organizations are still in use. We have not phased out any of them, since they are acting as information hubs for manufacturing. Sourcing is managed through Application 1, but the operations and what to deliver is managed through their own purchasing systems.*
>
> *Member of EPO*

According to EPO, Volvo 3P's portfolio of technologies and information has been growing increasingly diverse and complex and is rarely understood or documented. Respondent 1 states it like this:

> *We have the general issues of flexibility, difficulties related to legacy applications, lacking control as a result of recent mergers and acquisitions. The fact is that purchasing is the first division to plug-in in a merger situation.*
>
> *Respondent 1*

Since the application portfolio of Volvo 3P was firstly estimated to contain approximately 180 applications of various kinds, this was thought to be an area where savings could be achieved. The costs of the application portfolio were, however, not the only reason for undertaking the known to be voluminous work of unravelling the intricacies of the application portfolio. The main effect sought with the application portfolio initiative is to:

> *Strengthen control of our application portfolio.*
>
> *EPO presentation*

To achieve the objective, IT Platform Architecture has become a top priority in Volvo 3P Process and IT agenda for the following years. As illustrated in Figure 4-2, the IT Platform Architecture concern Volvo 3P business processes and application integration. The figure also depicts with areas that are important in the IT Platform Architecture, namely information and data modelling, business value, functional quality, user and organizational training, IT cost and technology.

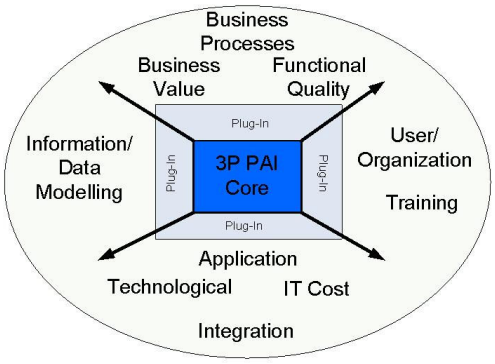

Figure 4-2 IT Platform Architecture (Source: Volvo 3P, 2008).

The approach, referred to as PAI (Platform Architecture Inventory), was initiated at Volvo 3P Purchasing in August 2007. The approach has, however, expanded to also become a permanent task of the entire business unit's process and IT community, not only a task for Purchasing. According to the CIO Network, a better management of

Volvo 3P's application portfolio will result in benefits such as lower operations and maintenance costs, shorten lead times to deploy or enhance applications and lower costs for developing interfaces to reach a more functional development to their end users. The intention is to have a gradual approach to ensure the maintenance of data and processes before going forward.

4.3 IDENTIFYING THE CURRENT APPLICATION PORTFOLIO (AS-IS)

The Platform Architecture Inventory (PAI), initiated by the CIO Network and the EPO team, constitutes a list of all applications within Volvo 3P which are seen as important for the evaluation of the application portfolio. The purpose of PAI is to find and examine the current application portfolio (as-is) in order to migrate towards the BU's target architecture later on. The collection of information about the applications started during the fourth quarter of 2007 and finished by the second quarter of 2008. The collection of the information has been done by two enterprise architects of the EPO team interviewing system owners and maintenance managers. In this section the workflow used for collecting information about the applications is described.

> *You have to know your as-is portfolio to be able to continue. The management felt that they were not in control. This project takes us in the right direction.*
>
> *Member of EPO*

PAI was set off by the CIO Network and the EPO team which together identified twenty of the BU's most important applications as a start, referred to as Priority 1. Priority 1 applications consisted of applications for sourcing, tooling, forecasting, purchasing, negotiations, ordering etc. The total amount of applications at Volvo 3P Göteborg was firstly estimated to 180. A later calculation, made in April 2008, showed a possession of over 300 applications.

> *We asked the managers in PU and PD "which are your most important applications?" and took these applications in the first round as Priority 1. When we did this, we also got a number of other applications which we labelled as Priority 2.*
>
> *Member of EPO*

In the next round, information concerning Priority 2 applications was collected. The Priority 2 applications include about the same business functions as the Priority 1 applications, but they are not as business critical as Priority 1. Smaller applications, exclusively used for document management, CAD, verification and validation etc., has been labelled as Priority 3. There are, however, some applications that are not included in PAI at all. Such applications are the administrative ones and applications in the desktop environment. Concluding this gives us a somewhat diffuse understanding for how Volvo 3P would like to define an application. An enterprise architect in the EPO team expresses it like this:

> *We define an application as something that has a budget, a system owner and is owned by Volvo 3P.*
>
> *Member of EPO*

To explain the work for the staff concerned, the EPO team held presentations for the system owners in order to communicate the vision of the PAI initiative. After that, the EPO team invited each system owner to a workshop. The invitation procedure was carried out mostly via e-mail. With every e-mail the EPO team attached a PAI document and instructions so the system owner could be prepared before the meeting.

At the workshop, which usually lasted for 1-3 hours depending on the number and complexity of the applications the system owner possessed, the EPO team firstly mapped the target applications in a business function view which is a rough map for the functionality provided by the application in each business function (namely Purchasing and Product Development). The purpose of this task was to provide the EPO team with an overall picture of the functionality of the application portfolio.

During our attendance of these workshops we found out that being the owner of an application does not come with any responsibility for knowledge about anything about the application. The role is connected only to a financial responsibility and it is the maintenance manager that knows about the technical aspects of the application such as the ones provided in Table 4-1 below. That is why the EPO team had to send additional inquires to the maintenance managers in order to fill in the technical aspects of each application.

Another issue brought up in one of the workshops was the stance of switch off and remove applications not being used. According to one system owner, there exist several gigabytes or terabytes of applications on their servers that no one bothers to move or remove.

> ***System owner**: Sometimes the applications are used, but I think we could actually remove some of them to save money. But I do not think the savings will be great.*
>
> ***Member of the EA Team**: This one costs 60,000 SEK a year. I do not think anyone wants to put 100 hours to get it fixed.*
>
> *Conversation between a system owner and a member of EPO*

In the next step, the EPO team collected information about each application based on different aspects (see Table 4-1). The inventory of the applications consists of a document where a number of fields are filled in with information about the applications.

> *We could have asked hundreds of questions, but we decided to keep this level of main functions and get the names of the staff who can answer more questions later.*
>
> *Member of EPO*

Table 4-1 Summary of content in the PAI sheet (Source: Volvo 3P, 2008).

Group	Description
General info	Name, ID and description of what the system is used for.
Business support	Which business function uses the application and which quality does it have.
Application	COTS application or Volvo developed and level of customization.
Technology	Information about platform, programming language, lines of code, database etc.
Ownership	Organizational owner and system owner.
Operations	Maintenance responsibilities and criticality for operations.
Usage	Number of users of the application and business units using the application.
Geographical Usage	Usage of the application Europe, US, Asia etc.
Application Life cycle	Information about when the application was produced and plans for its future.
Interfaces	Which other applications it is connected to.

The information provided in the PAI sheet enabled conclusions to be drawn about e.g. how old the average application is, how many percent of the applications are “Components of The Shelf” (COTS) and which platform and programming language is the most common etc. The conclusions about the applications are, however, confidential so we cannot display the exact outcome. The conclusions have shown that there are certain problem areas and that PAI is a way of finding out which applications that are in this problem area. To be able to do something about it you also need to know the relations to other applications, so these applications are not affected if you decide to make changes in the future.

4.4 FUTURE APPLICATION PORTFOLIO (TO-BE)

When the PAI initiative is finished, the EPO team will produce a report and publish the results on the Intranet. In addition, information about all the applications will also be updated in an application which holds all the information collected in the PAI initiative described earlier. On the other hand, no strategy for how to use the collected information has been defined at the time of our study. Since PAI rather can be described as a registry of

Volvo 3P's current application portfolio, the respondents have mentioned that it might be valuable to evaluate if a tool should be brought in to enable keeping the information updated during the application lifecycle. Volvo IT uses a tool for this purpose where you can see relations between domains and browse the applications to see the flow of information between the applications.

> *PAI is like the yellow pages.*
>
> *Member of EPO*

Once information about the applications within the business unit in Göteborg, including global applications, has been collected for all the applications the next step forward will be to go on with the same procedure on the BU's applications in headquarters in France.

> *Now we are about to make a to-be map of this portfolio. What will decide which applications that should remain? What makes these applications potential for the to-be map? It is tricky. I think that business demands should decide.*
>
> *Member of EPO*

In a larger context, the EPO team is currently setting up an integration office which is a process to be able to control the integration between the different business units around the world in a more effective way. The decision implies that the EPO team are also working with the IS/IT principles for the governance of projects in early phases.

5 ANALYSIS OF THE PORTFOLIO WORK PRACTICE

This chapter starts with an analysis of the academic concept of Application Portfolio Management and how this relates to the view of the organization. The second part contains a breakdown of how an application can be handled. In the final section the principles that are later used for creation of the framework are presented.

5.1 APPLICATION PORTFOLIO MANAGEMENT

Application Portfolio Management enables organizations to identify, monitor, finance, maintain and control the application flora at an aggregate level, which should also contribute to increasing the alignment between the business and IT (CIO Council, 2002). Positive effects can be obtained by directing resources to applications where most beneficial instead of simply updating applications based on gut feeling or technical criteria. The execution of the PAI initiative have this far been focused mainly on collecting information, which consists with the type of information used in what the scientific literature refer to as the assessment phase (Fabriek et al, 2007). Thus far, the work has been focused on information collection with just a few conclusions draw by the EPO team, which implies that the work has only reached an early stage of the assessment phase. The focus of the initiative is, according to a member of the EPO, to gain control of the application portfolio and the intent is to use the information as a directory. By analysing the information in the PAI sheet (see Table 4-1) a number of conclusions can be drawn, such as to update all applications using Visual Basic 6 since the environment is not going to be supported for much longer (www.microsoft.com). These conclusions are important and will allow for complexity reduction of the portfolio and update applications that are old or of poor quality. However, if a decision to fix the performance of an application is going to be made, it is important to have a complete picture of the application. If, for example, an application is written in an obsolete programming language and a decision is taken to upgrade it, without knowing how the application contributes to the business, the resources may be spent in vain. It is thus important to get a full picture of the applications before any decision is made. Furthermore, the average age of the application portfolio being 9 years at Volvo 3P is not by itself a reason to update it unless there are other problems. By using the PAI it is also possible to find out applications or functionality that is redundant. This problem has emerged through mergers and acquisitions, but deciding which of the applications to remain and which to remove is still problematic from the information collected, which implies that the issue of never turning off any applications will not be resolved from this information. Taking all the relevant factors for an application into account and not loosing track is difficult and a structured way to define an application could be beneficial for Volvo 3P.

In the scientific literature, application portfolio management is often associated with matrices. As narrated by Ward (1987), the academic research has been focused on models for plotting applications and giving an overview of all applications in the portfolio. Using these models is a way of obtaining an overview and find out in which area problems exists, e.g. that the portfolio has an overall low technical quality. However, using such models does not provide managers with enough information about the specific applications for making informed decisions. The matrices can be used to depict or visualize how the applications of an organization relate to one another in terms of, for example, business value and system quality such as the legacy matrix provided by Sommerville (2001). Doubts for the excellence of using a matrix for application portfolio management has been raised by Ward (1987), who states the main problem with matrices is that they are over simplistic. Matrices such as the application portfolio matrix (Ward & Peppard, 2002) and the legacy matrix (Sommerville, 2001) should consequently be no exception. A simplification of a complex situation limits the usefulness since no precision can be expected (Ward & Peppard, 2002), the matrices are however useful for obtaining an overview. This study provides a different solution (see chapter 6) to the matrices since we aim to support decision-makers at Volvo 3P in making better informed

decisions about what actions are best for dealing with the applications in the portfolio. The next section will introduce the four actions, or destinies, that we have distinguished.

5.2 DESTINIES FOR APPLICATIONS

Although the matrices may be over simplistic, they have assisted us to find out main actions for the applications. By concluding Sommerville (2001) and Weill and Vitale (1999), we have found four ways of dealing with an application, four destinies, which are referred to as:

- Remove
- Remain
- Redevelop
- Replace

The four destinies will have implications for the organization which needs to be considered. According to Sommerville (2001), removing a system as well as replacing it involves significant risk for the business due that there usually does not exist a complete specification of the application. The application may also have undergone major changes that have not been documented. If the decision is to replace the application the affected business processes must be evaluated. Business rules that have not been formally documented elsewhere may also be embedded in the system which is a consideration that must also be taken into account. Whatever the decision, it is important to have a complete picture of the application before a decision is made. It is also our opinion that it is necessary to know what other applications exist in the portfolio before determining what action is better. The information that Volvo 3P is collecting is a good start but need to be complemented in order to make the best decision. The next four sections offer a closer look at the four destinies.

REMOVE

The application is shut down permanently. Taking this road means that the application is not required by the organization and thus the question would be, why keep it? The implications of the decision to remove an application can be daunting if it, for instance, is a large legacy application. However, if the application is not bringing any value to the organization and it is clear that it will not contribute further in the future, resources should be directed to rid the organization of the application, which will imply lowering maintenance costs for the future. Volvo 3P have a large portfolio and have expressed a concern that more and more applications are added to the portfolio but that no applications are switched off and that new ones are continuously added which have resulted in lacking control. By looking at the portfolio from the heliview that the PAI initiative provides and from the discussions with the respondents, we have recognized that the growth of the portfolio is worrying and can only be resolved by finding a way to remove applications that are not deemed necessary. However, removing applications is as associated with removing something that was once considered important and the applications should be evaluated carefully before any decision is made (Sommerville, 2001).

REMAIN

No specific action is taken on the application. By determining that an application should not be removed it does not mean that no action should be taken. By examining if the application meets requirements, functionally as well as quality wise, it can be determined if it is better to leave the application as it is. This is probably the most common option, since resources are limited and not all applications can be dealt with instantly. It is logical to reason: why change it? Not: why not change it? Deciding to take action on an application based only on e.g. the fact that it is old will probably be a waste of efforts. Volvo 3P has drawn the conclusion that the applications in the portfolio have an average age of 9 years, which is on its own not a problem. An application could remain as it is if the resources and money spent on the application are acceptable considered the value it delivers to the business.

Furthermore, an application can remain as it is despite low value to the business if it is connected to, for instance, legal requirements. It is important to find out where to direct the resources to get the best effect.

REDEVELOP

The application can be changed to better suit the requirements of the organization. A decision to redevelop an application can mean for example adding functionality, increasing code quality, documenting it better or even taking functionality away. If a decision is made to redevelop an application, it is necessary to know that the application is required by the organization. Redeveloping an application can be relatively easy if it is well documented, new, well written and not integrated with other applications. However if the application has going through a lot of changes, it might be a resource consuming activity to redevelop the application. Knowing that the redevelopment is going to bring positive effects to the organization is thus important. Asking what changes are necessary is important due that redeveloping an application, for instance to another programming language, if the problem only lies in poor documentation is apparently a waste of resources that could be better used elsewhere. The information that Volvo 3P has collected in the PAI sheet about programming language can be useful for making a decision to redevelop all applications based on an old platform. However, if some of the applications are not adding any value to the organization, the effort is wasted. Therefore, before such a decision it is better to check which of the applications are actually worth the effort.

REPLACE

Instead of redevelop an application, an application can be replaced by an alternative solution. Replacement is an alternative solution to redevelopment of an application. If introducing an alternative at a lower cost than that of redeveloping the application is possible, such a decision could be recommended. It is however necessary to make an evaluation of the total cost of replacing the application. This alternative is also dependent of the availability of alternatives for purchase and the replacement could also end up even more expensive since the cost of lost productivity during education, problems during introduction and other aspects are hard to assess. Deciding whether to redevelop or replace an application also depends on the future value to the business of the application. If the functionality is likely to increase in importance, replacing the application may be better, providing that there is such an alternative for purchase. Since Volvo 3P also have redundancy in applications due to mergers and acquisitions, replacing two applications for one could be a feasible option. Replacing non standard applications which have been changed constantly for a long period of time may however be associated with risks (Sommerville, 2001).

5.3 PRINCIPLES FOR APPLICATION PORTFOLIO MANAGEMENT

If a decision is taken that, for instance, all applications using an obsolete programming language should be removed and replaced with newer technologies, an investigation like PAI is probably enough in order to capture which applications are using that programming language. But with more extensive and diffuse objectives, each application needs to be carefully evaluated on its value from more than a technical standpoint in order to reach a decision, or a destiny as we named it above. Ward (1987) related all dimensions used for describing the value of an application and found that the vertical dimension in most of the matrices considered the potential contribution of an application to achieve future business objectives. By this we conclude that assessing just the technical value of an application is not enough. As been emphasized by Swanson and Dans (2000), the age of an application is not an exclusive value which can determine the destiny for an application.

Determining the destiny of an application is in no way a straight forward task, since applications obviously differ in how they bring value to the organization and, thus, how they should be managed. As narrated by Ward and Peppard (2002), applications can be divided into Strategic, High Potential, Key Operational and Support. These four categories have their own characteristics and implications. For that reason it is important to be aware of the value

that each application contributes to the business. Some applications are meant to be supportive and these applications should be evaluated differently than applications that are important for strategic intents for the business. A support application should have more focus on technical and functional values as well as low expenses in terms of resources used. A strategic or a high potential application which delivers (or has the potential to deliver) high value to the business, has not the same requirements of being cost-effective (Ward & Peppard, 2002). When a decision should be made, it is always important to have a full picture of the application portfolio. In order to ensure that all aspects have been taken into account it is advantageous to use a set of principles for guidance.

By looking at the scientific literature and the empirical findings in this study, we have found four principles that cover many aspects that need to be considered when determining the destiny of an application. It is possible to use the contents of the different matrices and generate a set of principles that harmonize well with our empirical study performed at Volvo 3P. The four principles that affect how an application should be managed are:

- Business Value
- Functional Value
- System Quality
- Cost

These four principles are also based on what Volvo 3P finds important (Figure 4-2). From the PAI sheet it is likewise possible to see which of these principles have been considered when the initiative started (Table 4.1). Thus, we are looking at a set of principles that are consistent and agreed between academic research and the organization in our study and we believe that these four principles can be founded in both.

BUSINESS VALUE

The first thing to ensure when assessing and evaluating an application before planning for the destiny should be to find out the business importance of the application and how important the application is to meet business objectives. Is the application not that important, it might be a candidate for removal but it might also be a support or key operational application (Ward & Peppard, 2002) which has minor importance for sustaining competitive advantages, but have major importance to avoid competitive disadvantages or to sustain the effectiveness and efficiency. This takes us to the next issue, if removal of the application has implications for productivity and/or long term costs. According to Ward and Peppard´s (2002) definition, an application should support particular tasks but also support a specific business activity or a process. If the application does not currently support any task, activity or process the next question should be related to the future potential. Hence, it is necessary to reflect what the application may bring to the organization in the future, as some applications are not used to the full potential.

Even if the application does not provide business benefits or support work duties in the organization, the application can deliver business value since it might enable the organization to meet legal requirements (such as SOX, Sarbanes-Oxley Act). In addition, is it possible that the application contains critical information that other applications are dependent of.

Assessing the value an application brings to the business might be a difficult task based on subjective judgements. To ensure that you do not get a skewed value, Sommerville (2001) suggests a viewpoint-oriented approach were you identify a number of business viewpoints and make value assessment from each one of them in order to get a fair picture of the circumstances. We believe that the work Volvo 3P has performed so far is of sufficient reliability. They have consulted the EPO team in order to perform the PAI initiative. The EPO team has in turn performed workshops with system owners, and sometimes maintenance managers, for each application. One weakness we can distinguish is that they have not asked the users of the applications. The questions asked concerning functionality and user friendliness are only based on the judgements of the system owners, which lead us in to the core of the next principle.

FUNCTIONAL VALUE

As described by Weill and Vitale (1999), the usage of an application is associated with how user friendly the application is. Managers need to consider how easy it is for a new user to become comfortable with the application, which help facilities there is, how the menus are designed, the status of the user documentation, screen prompts, but also general system complexity. If the application manages an important business process the business value of the application is high, but if the application is not sufficiently user friendly, it is useless. If an application should be used properly, it is also important to ensure that there is sufficient knowledge about the application for training. These issues are important to consider when assessing an application. Volvo 3P includes this kind of information in their PAI sheet.

There are obviously values of an application that may not provide business value in terms of competitive advantages. These values are either based on the technical qualities of an application such as software or hardware. We would rather define functional value in between these two sets of values. Weill and Vitale (1999) refer functional value to the usage of an application, "value of use". In accordance with Volvo 3P, functional value refers to the extent that an application supports a defined process, in contrast with Sommerville (2001) who places functional aspects in system quality. There is also important to determine if the functionality of an application is redundant or not. Because of mergers and acquisitions, Volvo 3P has redundant functionality for several of their applications (an example will be provided in chapter 7). Functionality can be unused because of the same functionality provided by a more frequently used application. For this, adjustments must be made in order to save superfluous maintenance efforts (money) for these applications.

Volvo 3P applies the business function view in order to map the functionality of an application to a heliview of their whole portfolio. This was, however, a task criticized by some of the system owners as the business function view was not fully corresponding the reality. We believe that the business function view provides a sufficient overview of the functionality of their application portfolio in a first stage, but that there is a need to develop the business function view if it should be further used.

SYSTEM QUALITY

System quality is the technical value of an application which refers to characteristics such as data accuracy and reliability, source code quality, output quality and response time (Weill & Vitale, 1999). This is important factors to consider, because technical problems will cause extra maintenance work and, hence, consume resources in terms of money. This is perhaps the most extensive area of the PAI sheet. Below, we have reviewed the most important factors of system quality in order to limit the number of questions needed to be answered.

To assess the system quality of an application, managers need to know if the performance of the application is sufficient. By performance we refer to response time, availability, up-time and efficiency. If the performance is not sufficient, it is important to find out where the efforts should be located. It is also important to consider the failure rate of the application and if the application is connected to acceptable maintenance efforts. If the maintenance efforts of an application are too resource consuming than the business value it delivers, this is an area that needs to be more carefully reviewed. If the application can be categorized as a support application, one major objective for the application is to be cost-effective (Ward & Peppard, 2002) otherwise the application should be reviewed as a candidate for some kind of change. In addition, it is important that there is sufficient knowledge for maintenance of an application within the organization.

Another important factor to consider is the technical infrastructure of the application. If an application is built upon an obsolete technology that no longer will be supported by its supplier, this is a problem which has to be taken into consideration. Obsolete programming languages are also a technical issue as well as issues related to lacking source code quality because poor source code quality can result in doubtful output from an application.

COST

The matter of cost is an obvious factor which has diverse importance for the three principles mentioned above. As narrated by Ward and Peppard (2002), investment justifications differ during the life cycle of an application because of changing business demands. For Support and Key Operational applications the aspects are better known than for Strategic and High Potential applications, which make it easier to make financial justifications for such applications. With known aspects, the cost or "investment value" (Weill & Vitale, 1999) of an application is an objective measure which can be used to compare applications. The PAI initiative has not expressly been defined as a cost-saving effort and the PAI sheet does not contain any specific post for costs, but the initiative are letting Volvo 3P know their application portfolio which provide opportunities to locate operations and maintenance costs, reduce redundant applications, determine failure rate, and assess technical quality in terms of hardware and software which in turn can reduce costs.

As stated by Ward and Peppard (2002), it is important to be aware of the four different management approaches mentioned above (Support, Key Operational, Strategic and High Potential) in order to achieve a balance of resource use to business contribution. Business contribution, or business value, is accordingly the most important factor for the existence of an application. It is consequently essential to assess if operations and maintenance costs of an application can be regarded acceptable to the business contribution it provides. If the application does not provide sufficient value to the business, an evaluation should be made in order to find out if it is possible to redevelop the application or if replacing the application with a new one is a better and more economical alternative.

6 FRAMEWORK FOR APPLICATION DESTINY DETERMINATION (FADD)

This chapter starts with an explanation of the fundamentals of the framework and how it should be used at an aggregate level. Thereafter, the logic of each step in the framework is presented and the final section contains some criticism to the framework.

6.1 GENERAL FRAMEWORK DESCRIPTION

Decision-makers have a difficult task in deciding what action is better for the applications in the portfolio. The Framework for Application Destiny Determination (FADD) has been developed with simplicity, agility and accuracy in mind. The framework meets these criteria in means that it is easy to use, it is not regarded as time consuming and that it still gives enough information to support a decision, which is important since evaluation of hundreds of applications otherwise will be connected to huge amounts of resources and money spent.

The framework (Figure 6-1) is based on the assumption that there are four ways of dealing with an application, four destinies which are, for simplicity referred to as: Remove, Remain, Redevelop and Replace. FADD is also based on the four key principles for application portfolio management as described in section 5.3: Business Value, Functional Value, System Quality and Cost. Looking at the principles and the destinies all at once is cumbersome, thus a sequence is defined in the framework that facilitates the revision of an application. The objective of FADD is to find the rationale for each destiny and define an intuitive sequence to adhere to in order to find out the proper way to manage an application. Thus, the sequence of the framework is based on the rationale that if an application is not necessary, it should be removed, if it is necessary and of sufficient quality it should remain. If the application is not a candidate for removal, nor for remaining as it is, some action is needed. The remaining step is, thus, to find out if it can be adjusted, i.e. redeveloped to better support the business or increase the quality, or if that is not feasible, if it can and should be replaced by an alternative solution. FADD is constructed in a way that simplifies the evaluation of an application by going through the destinies in a sequence where every step that is passed excludes the alternative.

In the framework, green and red colouring is used for representing ´yes´ and ´no´ answers. The reason for using colours is that it makes the result easier to read. The colours are not meant to be positive or negative, but are simply a way of representing the answers in an easy to read manner.

Step 1 Remain or Remove	**Step 2** Remain or Change	**Step 3** Redevelop or Replace
Is the application important for any specific business objectives?	Does the application support the appointed process in a satisfactory way?	Is the application unique on the market?
Does the application improve productivity and/or reduce long term costs?	Is there sufficient knowledge about the application for training?	Is business logic inscribed into the application?
Does the application have potential to provide benefits not yet known?	Is the performance of the application sufficient?	Does the application contain redundant or unused functionality?
Does the application enable the organisation to meet legal requirements?	Is the output from the application reliable and accurate?	Are other applications dependent on the target application? (interfaces)
Does removing the application result in a business disadvantage?	Is the functionality of the application unique (not redundant)?	Will the total cost of replacing the application be higher than that of transforming it?
Does the application contain information that is critical? (master information object)	Is the application sufficiently user friendly?	Can the application be enhanced/simplified to better meet business needs?
	Can maintenance costs for the application be regarded acceptable?	
	Does the application have a low rate of failures?	
	Is the application built upon non obsolete technologies?	
	Is the application connected to acceptable maintenance efforts?	
	Is there sufficient knowledge for maintenance of the application?	

Yes No

Figure 6-1 Framework for Application Destiny Determination (Source: Own developed)

6.2 FRAMEWORK SEQUENCE

6.2.1 STEP 1: REMOVE OR REMAIN

The first decision, if an application should be completely removed is dependent on its contribution to the business, today and in the future. If all the questions in Step 1 are answered ´no´, the framework points to a complete removal of the application. If one or more of the questions is answered ´yes´ the application is not a candidate for removal at this stage and Step 2 should be visited. The decision to remove an application should be based on its contribution to the business and the questions in the framework are aimed at finding out if the application does not bring value to the organization now or in the future. It may be clear after evaluating Step 1 that an application is not bringing anything to the organization, but it may still be a good idea to go through the other steps in order to get a complete notion of the application.

6.2.2 STEP 2: REMAIN OR CHANGE

In Step 2, the questions are focused on deciding whether the application is in condition to be left as it is. For making the decision there are two principles that are in focus, Functional Value and System Quality. If the Functional Value and System Quality are sufficient, there is no need to make any changes to the application. This step will also give a hint as to what the problem of the application might be if any question is answered ´no´. If the application is not in shape to be left as it is, some action has to be taken. When the step is answered with a mix of ´yes´ and ´no´ answers it is possible to get an idea about how urgent it is to take action. For example redundant functionality is not something that the organization undeniably must suffer from more than economically. Since resources are usually scarce, it is not possible to treat every single issue. Thus, the questions are formulated not to find out if there is a problem, but if the problem is of such a magnitude that it have to be treated.

6.2.3 STEP 3: REDEVELOP OR REPLACE

There are, basically two ways of dealing with an application that should not be removed nor remain, that is to redevelop it or to replace it with an alternative solution. Step 3 is a matter of seeing which alternative is more feasible considering the problems from Step 2 but also taking in cost and aspects such as availability of an alternative. If an alternative does not exist for purchase the alternative can usually be dismissed, and redevelopment is the only valid option. It is important to keep in mind that for example an application implemented in an old programming language should not be redeveloped solely based on that kind of problem but that the efforts should to bring value to the organization. Cost is a key principle which should be considered throughout the use of the framework but has a greater focus in Step 3 since both alternatives are connected with costs and alternatives must be investigated before a decision is made. It is however possible to use the framework to see which alternative would be the most advantageous for the organization if the cost is not an obstacle. Step 3 is a special case where none of the alternatives is distinctively better than the other; both alternatives involve different amounts of work. For example, replacing an application which is standalone and not information critical can be a quite an easy task but if it is integrated with other applications a redevelopment may be easier.

6.3 CRITICISM OF THE FRAMEWORK

If an application is, for example, evaluated and the framework points to a removal it is not always a question of just switching the application off. The removal of an application could involve e.g. moving or transferring data which may be a time and resource consuming venture and since resources are limited it is important to direct them where most beneficial. When a decision is made it is important that aspects such as this are taken into account and some of them are answered through the framework even though more evaluation can be necessary after the destiny has been determined.

Every question that is answered may have implications, however it is important to use the framework without going into detail in order not to spend too much time. This is probably both strength and weakness of the framework. The strength being that it does not require a great deal of time, the weakness is that it does not give total insight into the applications.

Another criticism of the framework comparing it to the matrices is that it does not give an overview of the portfolio. That is, relate the applications in the portfolio to one another such as in a matrix. This is however not the purpose of the framework and the matrices with this intent exist and can be used as a complement to the framework or vice versa.

To ensure the usefulness and understandability of the framework for the business unit in this study, an evaluation was performed on two applications in cooperation with two decision-makers of the business unit in our study. The result will be presented in the following chapter.

7 EVALUATION OF THE FRAMEWORK

In this chapter the Framework for Application Destiny Determination is evaluated on two purchasing applications within Volvo 3P in order to explore if it is useful for the organization. The evaluation was carried out as a workshop with two employees at Volvo 3P and showed that the purpose of the framework is satisfying for decision-makers in the business unit where this study was carried out.

The intention of the Framework for Application Destiny Determination (FADD) is to help managers to make better informed decisions about applications in the portfolio. In order to assess if the framework is useful for the purpose, an evaluation was performed in cooperation with Respondent 1 and Respondent 2. For the evaluation, a prototype was used and the evaluation was performed as a workshop where an introduction to the framework was first provided and thereafter it was applied on two applications, Application 1 and Application 2. Application 1 is primary used within Volvo 3P for the purchasing process; the result of the evaluation is presented in section 7.1 and illustrated in Figure 7-1. Application 2 is a similar purchasing application, but used in Volvo 3P France. The evaluation is presented in section 7.2 and illustrated in Figure 7-2. The choice of applications was based on which applications that the respondents had a good knowledge about.

7.1 APPLICATION 1

The logic of FADD is that for an application to be removed, a negative answer is required for all the questions in the Step 1, which was clear to the respondent who answered 'yes' to the first question and immediately reflected that the application cannot be removed. However, in order to get the full picture of the framework the respondents were asked to answer all the questions in the three steps which in the end proved to give useful insights.

When approaching the third question the answer was not as straightforward and the question of using a third colour which would represent ´maybe´ was raised. This was, however, abandoned since the questions are aimed at being answered ´yes´ or ´no´. Using ´maybe´ would be counterproductive and usually a ´maybe´ answer is a negative answer or perhaps should be answered by different person. The rest of the questions were answered with no further ado accept for questions two and four in Step 2, which were first considered yellow but later decided upon to be red.

The result of the evaluation of Application 1 shows that it has a high degree of business value since all the fields in Step 1 were answered ´yes´, which is easy to discern using colours. Moving on to Step 2, it is easy to see that the functional value and system quality of the application is not adequate for leaving it as it is. The answers herein also give a good hint about what the problem/problems with the application may be.

Reading the results from Step 3, it was concluded that the application is better off to be redeveloped since no alternative solution exists as a valid option. Reading the result was experienced easy, the application is important and cannot be removed, Application 1 is not in a good condition so it should not remain as it is and there is no alternative for purchase so it should be redeveloped. The answers in Step 2 implies what is needed to be done but also that it is both functional value and system quality issues that need to be improved.

Step 1 Remain or Remove	Step 2 Remain or Change	Step 3 Redevelop or Replace
Is the application important for any specific business objectives?	Does the application support the appointed process in a satisfactory way?	Is the application unique on the market?
Does the application improve productivity and/or reduce long term costs?	Is there sufficient knowledge about the application for training?	Is business logic inscribed into the application?
Does the application have potential to provide benefits not yet known?	Is the performance of the application sufficient?	Does the application contain redundant or unused functionality?
Does the application enable the organisation to meet legal requirements?	Is the output from the application reliable and accurate?	Are other applications dependent on the target application? (interfaces)
Does removing the application result in a business disadvantage?	Is the functionality of the application unique (not redundant)?	Will the total cost of replacing the application be higher than that of transforming it?
Does the application contain information that is critical? (master information object)	Is the application sufficiently user friendly?	Can the application be enhanced/simplified to better meet business needs?
	Can maintenance costs for the application be regarded acceptable?	
	Does the application have a low rate of failures?	
	Is the application built upon non obsolete technologies?	
	Is the application connected to acceptable maintenance efforts?	
	Is there sufficient knowledge for maintenance of the application?	

Yes No

Figure 7-1 Framework for Application Destiny Determination applied on Application 1 (Source: Own developed)

Step 1 Remain or Remove	Step 2 Remain or Change	Step 3 Redevelop or Replace
Is the application important for any specific business objectives?	Does the application support the appointed process in a satisfactory way?	Is the application unique on the market?
Does the application improve productivity and/or reduce long term costs?	Is there sufficient knowledge about the application for training?	Is business logic inscribed into the application?
Does the application have potential to provide benefits not yet known?	Is the performance of the application sufficient?	Does the application contain redundant or unused functionality?
Does the application enable the organisation to meet legal requirements?	Is the output from the application reliable and accurate?	Are other applications dependent on the target application? (interfaces)
Does removing the application result in a business disadvantage?	Is the functionality of the application unique (not redundant)?	Will the total cost of replacing the application be higher than that of transforming it?
Does the application contain information that is critical? (master information object)	Is the application sufficiently user friendly?	Can the application be enhanced/simplified to better meet business needs?
	Can maintenance costs for the application be regarded acceptable?	
	Does the application have a low rate of failures?	
	Is the application built upon non obsolete technologies?	
	Is the application connected to acceptable maintenance efforts?	
	Is there sufficient knowledge for maintenance of the application?	

Yes No

Figure 7-2 Framework for Application Destiny Determination applied on Application 2 (Source: Own developed)

7.2 APPLICATION 2

Application 2 that was evaluated using FADD is also a purchasing system which is used in Lyon, France and has a similar functionality to Application 1. At the start of the evaluation it was clear that the application was seen as problematic by the respondents. The evaluation of the application showed to the aggravation of the respondents that a removal of the application was not an option at this stage. The reason for this is that the application contains information that is critical to the business and is required to meet statutory requirements. The answers in Step 2 show without a doubt that the application is in a poor condition and some action is needed. From the answers in Step 3 it is possible to see that alternative solutions exist and that would probably be the best way forward. However, it is important to consider that business logic is inscribed into the application and that other applications are dependent on it, which means that replacing it will most likely not be a straightforward task.

7.3 RELEVANCE OF THE FRAMEWORK

Following the presentation and evaluation of the framework, the first comment from Respondent 1 was that he liked it and that the framework would come in handy. Due to the brief explanation that was given about how to use the framework, this indicates that the prototype which was presented was not experienced as superfluous, incomprehensible or abstruse, but that it can be penetrated without a big effort. After further discussion about how the framework could be used Respondent 2 agreed that it can be useful and that it may be used as a foundation for further work within the CIO network.

Respondent 2 has been responsible for collecting the information in the PAI sheet. Thus, this indicates that the framework can give new insights to how the information in the PAI sheet can be used and which further information that may be necessary to collect in order to enable well-grounded decisions about the destiny of applications.

To be able to trust the information in FADD, the information must have been collected through a reliable method. The viewpoint-oriented approach, suggested by Sommerville (2001), is one way to ensure trustworthy value assessment for the applications.

8 CONCLUDING DISCUSSION

The concluding discussion will present the conclusions that have been made from the analysis in chapter five in addition to a brief discussion about the evaluation of the framework in chapter seven. This chapter will provide answers to the problem of this master thesis, but also present the academic contribution and recommendations for the business unit in our study. The final part of the chapter contains a few suggestions for further research.

Since the subject of this master thesis was Application Portfolio Management and the purpose was to create a framework for supporting decision-makers in making better informed decisions about what actions are best for dealing with the applications in the portfolio, the research questions of our study were:

Which principles are key to successfully manage an application portfolio?

How can application destiny decisions be supported by these principles?

During our study we have concluded application portfolio management to be an extensive area which is increasing in importance due to the rapidly growing flora of applications that organizations are facing. We have also observed that the solutions provided by the scientific literature are mainly focused on matrices for managing application portfolios, which are limited by being too simplistic for informed decision-making. Furthermore, we hold the decisions too complex for the information that two dimensional matrices can provide.

An application portfolio management initiative is not as straightforward as can be imagined and the outcome is dependent on a number of elements. Starting from the desired result we conclude that an application can be dealt with in four ways, four destinies:

- Remove – The application is completely removed due to its low contribution to the business.
- Remain – The application contributes to the business and is in good condition.
- Redevelop – The application contributes to the business but need improvements.
- Replace – The application can be replaced by a better alternative.

In order to decide which of the four destinies is better for an application it is important that no aspect of the application is overlooked during evaluation. When examining scientific literature on the subject of application portfolio management and our study performed at Volvo 3P, we have found four fundamental principles which are important when assessing an application:

- Business Value – The value that the application brings to the business.
- Functional Value – The value of the application based on its functionality.
- System Quality – Technical qualities of the application such as programming language, size, complexity.
- Cost – Consists of costs for purchasing, operations and maintenance of the application in relation to delivered Business Value, Functional Value and System Quality.

The intention of the four principles is to cover relevant aspects in order to support decision-makers when picking out candidates for which applications that should remain and which application that should be removed, redeveloped or replaced. Looking at the principles and the destinies all at once is cumbersome, thus a sequence has been defined in the Framework for Application Destiny Determination that facilitates the revision of an application. By using reverse engineering, starting from the decision and the rationale that there are basically four different ways of dealing with an application, it was possible to define a logical sequence which works by the exclusion method. Instead of plotting all applications based on e.g. business value and system quality into a matrix, which from one point of view offer a good idea about the health of the total portfolio, the Framework for Application Destiny Determination evaluates each application separately.

By using the framework, managers can in a relatively short time assess and decide the destiny of an application. The idea with the framework is not to make the decision, but merely to provide guidance to which destiny is better for an application based on a set of criteria that are applicable for most applications. The framework was, during the work with the master thesis, evaluated by the Global Process and IT Manager at Volvo 3P and a member of the EPO team. The evaluation of the framework indicates that the business unit would benefit from using it and although the evaluation was not comprehensive, the outcome implies that the framework is useful, understandable and practically applicable. The framework is a prototype and, like for most models, adjustments are necessary for each organization that considers using it since every organization has different needs.

The academic contribution of the framework created in this master thesis is to close, or at least reduce, the gap between the use of oversimplified application portfolio matrices and reaching a well-informed decision about the best destiny for an application. By taking the one application perspective instead of representing the whole portfolio the Framework for Application Destiny Determination can give a clearer image of the specific application and help to pick out candidates for which application that should remain and which applications that should be removed, redeveloped or replaced.

Our recommendation to Volvo 3P is to use the framework as a foundation for further investigating the application portfolio. By letting more people in the organization work with the framework, additional insights may be accomplished and hopefully the use of the framework will be a step in the right direction. Considering the reaction from the organization, it is likely that even if the framework will not be used in this specific shape, the concept and the logic behind it may provide useful.

8.1 FURTHER RESEARCH

The framework that was created during this master thesis was evaluated with two employees at Volvo 3P, none of them actually being an operative user of the applications that were evaluated. An investigation of which stakeholders are best suited to answer the questions could also raise the integrity of the framework.

Furthermore, throughout the study, we have seen a need for better defining the responsibilities for the applications which would probably be an interesting investigation. Perhaps the Framework for Application Destiny Determination could also be useful for the employees with responsibility for applications. Such an investigation would give a richer and perhaps more reliable evaluation and could provide some new insights to aspects that might not have been brought to light.

LIST OF REFERENCES

Bell, J. (1995), Introduktion till forskningsmetodik. [Book]. / Lund : Studentlitteratur, Catchpole, L. (2004). Model Your Enterprise: Enabling True Business Process Management through End-to-End Enterprise Modelling. [Journal]. / M1 Global Solutions, Inc.

CIO Council. (2002). A Summary of First Practices and Lessons Learned in Information Technology Portfolio Management. [Journal]. / Washington, DC.

Fabriek, M., Brinkkemper, S., & van Dullemen, J. (2007). A Method for Application Portfolio Rationalization. [Report] / Institute of Information and Computer Science. - Utrecht : Utrecht University.

Henderson, J. C., & Venkatraman, N. (1999). Strategic alignment: Leveraging information technology for transforming organizations. [Journal]. / IBM Systems Journal, 1999. - Vol. 38.

Hirvonen, A. P. (2004). Application portfolio models in practise - tools for ICT planning, management and business value evaluation. [Journal]. / Jyväskylä, Finland : TietoEnator Corporation.

Holme, I. M., & Solvang, B. K. (1997). Forskningsmetodik. [Book]. / Lund : Studentlitteratur, 1997. - Vol. Andra upplagan.

Horner Reich, B., & Benbasat, I. (1996). Measuring the Linkage between Business and Information Technology Objectives. [Journal] / MIS Quarterly. Management Information Systems Research Center, University of Minnesota, March. - 1 : Vol. 20. - pp. 55-81.

Hanna, M. (1993), Maintenance Burden Begging for Remedy, [Journal] / Software Magazine (I 3:6), pp. 53-63.

Irani, Z. (2002). Information systems evaluation: navigating through the problem domain. [Journal] / Information and management. Elsevier Science. - Vol. 40. - pp. 11-24.

Kwan, S. K., & West, J. (2004). Heterogeneity of IT Importance: Implications for Enterprise IT Portfolio Management. [Report] / San José: San José State University.

Lin, C., & Pervan, G. (2001). A Review of IS/IT Investment Evaluation and Benefits Management Issues, Problems, and Processes. [Journal]. / Idea Group Publishing.

Lindström, Å. (2006). An Approach for Developing Enterprise-Specific ICT Management Methods – from Architectural Principles to Measures. IAMOT. [Conference] / Royal Institute of Technology / KTH, Dep. of Industrial Information and Control Systems

Löwstedt, J., & Stjernberg, T. (2006). Producing management knowledge. [Book]. Routledge.

Magoulas, T., & Pessi, K. (1998). Strategisk IT-management. [Doctoral dissertation] / University of Göteborg, Department of informatics.

Marco, D. (2002). IT Portfolio Management: Meta Data and Knowledge Management. [Journal] / DM Review Magazine.

Marshall, C., & Rossman, G. B. (1998). Designing Qualitative Research. [Book] / Sage Publications.

McFarlan, F. W., McKenney, J. L., & Pyburn, P. (1983). The Information Archipelago -- Plotting a Course. [Journal] / Harvard Business Review.

Menke, M. (2006). Product Portfolio Management in the context of Enterprise Portfolio Management. [Journal] / Digital Object Identifier 10.1109/PICMET.2006.296863.

Nhampossa, J. L. (2004). Strategies to Deal With Legacy Information Systems: A Case Study from the Mozambican Health Sector. [Report] / Department of Informatics ; University of Oslo.

Renkema, T. J., & Berghout, E. W. (1996). Methodologies for information systems investment evaluation at the proposal stage: a comparative review. [Journal] / Information and Software Technology, Elsevier Science. Vol. 39. – pp 1-13.

Robson, C. (2002). Real world research. [Book] / Oxford:Blackwell, 2002. - Vol. 2nd Edition .

Sarissamlis, S. (2006). A Sea of Applications: Portfolio Rationalization. [Journal] / Nautilus Advisors.

Sommerville, I. (2001). Software Engineering. [Book]. - 2001. - Vol. 6th Edition.

Swanson, B. E., & Dans, E. (2000). System life expectancy and the maintenance effort: exploring their equilibration. [Journal] / MIS Quarterley, Jun 2000. - 2 : Vol. 24. - pp. 277-297.

Thorp, J. (2001). The benefit realization approach to IT investments. [Journal] / Idea Group Publishing.

Trost, J. (1994). Enkätboken. [Book] / Lund : Studentlitteratur.

Ward, J. (1987). Information Systems & Technology Application Portfolio Management - An assessment of matrix based analyses. Cranfield [Report] / Cranfield school of Management, Cranfield University.

Ward, J., & Peppard, J. (2002). Strategic Planning for Information Systems. [Book] / Third edition. John Wiley & Sons, Ltd.

Weill, P., & Broadbent, M. (1998). Leveraging the new infrastructure, How Market Leaders Capitalize on Information Technology [Journal] / Harvard Business School Press.

Weill, P., & Vitale, M. (1999). Assessing the Health of an Information Systems Application Portfolio: An Example from Process Manufacturing. [Journal] / MIS Quarterly. 23, No. 4.

INTERNET SOURCES

BRINT Institute website. (2008-05-01), from World Wide Web: http://www.microsoft.com

Microsoft Cooperation website. (2008-03-15), from World Wide Web: http://www.brint.com

Volvo Group website. (2008-02-01), from World Wide Web: http://www.volvo.com